

# Chiral Biomarkers in Meteorites

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## ABSTRACT

The chirality of organic molecules with the asymmetric location of group radicals was discovered in 1848 by Louis Pasteur during his investigations of the rotation of the plane of polarization of light by crystals of sodium ammonium paratartrate. It is well established that the amino acids in proteins are exclusively Levorotary (L-aminos) and the sugars in DNA and RNA are Dextrorotary (D-sugars). This phenomenon of homochirality of biological polymers is a fundamental property of all life known on Earth. Furthermore, abiotic production mechanisms typically yield racemic mixtures (i.e. equal amounts of the two enantiomers). When amino acids were first detected in carbonaceous meteorites, it was concluded that they were racemates. This conclusion was taken as evidence that they were extraterrestrial and produced by abiologically. Subsequent studies by numerous researchers have revealed that many of the amino acids in carbonaceous meteorites exhibit a significant L-excess. The observed chirality is much greater than that produced by any currently known abiotic processes (e.g. Linearly polarized light from neutron stars; Circularly polarized ultraviolet light from faint stars; optically active quartz powders; inclusion polymerization in clay minerals; Vester-Ulbricht hypothesis of parity violations, etc.). This paper compares the measured chirality detected in the amino acids of carbonaceous meteorites with the effect of these diverse abiotic processes. IT is concluded that the levels observed are inconsistent with post-arrival biological contamination or with any of the currently known abiotic production mechanisms. However, they are consistent with ancient biological processes on the meteorite parent body. This paper will consider these chiral biomarkers in view of the detection of possible microfossils found in the Orgueil and Murchison carbonaceous meteorites. Energy dispersive x-ray spectroscopy (EDS) data obtained on these morphological biomarkers will be presented to show that the elemental compositions of these morphological biomarkers are not consistent with the compositions expected for modern (i.e. post-arrival) biological contaminants.

**Keywords:** Biomarkers, chirality, carbonaceous meteorites, Orgueil, Murchison, microfossils, EDS

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